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**APPLICATION UNDER UNITED STATES PATENT LAWS**

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Invention: System For Monitoring And Controlling Machines Used In The Manufacture Of Tobacco Products

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This is a:

- ☐ Provisional Application
- ☐ Regular Utility Application
- ☐ Continuing Application
  - ☐ The contents of the parent are incorporated by reference
- ☒ PCT National Phase Application
- ☐ Design Application
- ☐ Reissue Application
- ☐ Plant Application

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**SPECIFICATION**

This application is the national phase of international application PCT/IB2004/003766 filed November 11, 2004 which designated the U.S. and that international application was published under PCT Article 21(2) in English. This application claims priority to Italian Patent application number BO2003A000684, filed November 17, 2003, which is incorporated by reference herein.

Description

A system for monitoring and controlling machines  
used in the manufacture of tobacco products

Technical Field

The present invention relates to a system for monitoring and controlling machines used in the manufacture of tobacco products.

Background Art

Advantageously, the invention finds application  
5 in complete lines of equipment for the manufacture of tobacco products, and in particular cigarettes, comprising not only cigarette making machines but also filter tip attachment machines operating in combination with the cigarette makers.

10 The invention is concerned in particular with the quality control of cigarettes taken from the machines in question during the course of the production cycle, and in particular of cigarettes taken from the outfeed end of the line, that is to  
15 say, finished cigarettes complete with filter tip and print.

The task of quality-testing sample cigarettes taken from key points along the line is entrusted currently to a skilled operator who, at given  
20 regular intervals of time during the production

cycle, will take a single sample and present it manually to a testing station in which certain characteristics of the cigarette are verified both by hand and with instruments, for example the quality of the outer surface and the print, the correct alignment of the tipping paper, and so forth.

Thereafter, the operator will make adjustments to the cigarette maker or the filter tip attachment machine so as to correct the operating parameters and remove the causes of any defects that may be observed in the sample cigarette.

It will be clear enough from the foregoing that this method of operation, which involves the use of skilled labour both for testing the characteristics of the cigarettes and for making adjustments to the machines, is particularly costly and unreliable, also that response times in respect of the testing procedure are somewhat lengthy.

In-line quality checks, on the other hand, and in particular those involving an optical inspection of the outer surface presented by the cigarettes, tend not to be very trustworthy by reason of the high speeds at which machines of the type in question typically operate.

The object of the present invention is to provide a system for monitoring and controlling machines used in the manufacture of tobacco products, in particular cigarettes, such as will be unaffected by the aforementioned drawbacks attributable both to

testing systems relying on manual input, and to checks performed along the production line.

#### Disclosure of the Invention

The stated object is duly realized in a system for monitoring and controlling machines used in the manufacture of tobacco products, as characterized in any one or more of the appended claims.

The invention will now be described in detail, by way of example, with the aid of the accompanying drawings, in which:

- 10 -figure 1 illustrates the layout of a monitoring and control system associated with a cigarette making line, viewed in perspective;
- figure 2 shows an enlarged detail of the system in figure 1, illustrated schematically and viewed in perspective;
- 15 -figures 3 and 4 are portions of the detail shown in figure 2, illustrated schematically and viewed in perspective;
- figure 5 shows the detail of figure 2 from a different standpoint, illustrated schematically and viewed in perspective;
- 20 -figure 6 shows the detail of figure 2 in a second embodiment, illustrated schematically and viewed in elevation;
- 25 -figure 7 shows a final portion of the detail in figure 6, illustrated schematically and viewed in perspective.

Referring to figure 1 of the drawings, 1 denotes a

line for manufacturing tobacco products, such as cigarettes 2, comprising a cigarette maker 3 and a filter tip attachment machine 4, each equipped with a plurality of production devices and units to be described hereinafter.

Associated with the line 1 is a monitoring and control system denoted 5 in its entirety, of which more will be said in due course.

The cigarette maker 3 includes a plurality of the aforementioned production devices and units, and more precisely, proceeding upstream to downstream, a carding unit 6 supplied from a feed hopper (not indicated) with tobacco, which is taken up by a carding roller 7 operating in conjunction with an impeller roller 8, and directed into a descent channel or chute 9, passing thence by way of a belt conveyor 10 to an ascent channel or riser 11.

The top end of the riser 11 is enclosed by an aspirating belt 12 on which particles of tobacco are caused to form gradually into a continuous stream 13 providing a filler for the cigarettes 2.

The stream 13 of tobacco is advanced together with a continuous strip 14 of paper decoiling from a roll 15, following a path along which a printer device 16 is stationed, and passes onto a forming beam 17 along which the paper strip 14 is wrapped around the stream 13 to form a continuous cigarette rod 18.

The rod 18 advances toward a cutting station 19 where it is divided up by a rotary cutter device 20 into cigarette sticks 21 of predetermined constant

length, and more exactly of length twice the length of a stick equivalent to a single cigarette 2.

22 denotes a transfer device by which the double length cigarette sticks 21 are directed through an  
5 infeed roller stage 23 of the filter tip attachment machine 4 and into a cutting station 24 where each is divided into single cigarette sticks 25 by the action of a roller 26 and a disc cutter 27.

The single sticks 25 are transferred from the  
10 roller 26 of the cutting station, by way of a distancing roller 28 that serves to separate each pair of sticks 25 axially one from another, to an assembly roller 29 where a double length filter plug 30 is placed between the two sticks 25 of each  
15 successive pair, the filter plugs being dispensed from a feed unit denoted 31 in its entirety.

The resulting assemblies, each composed of two single cigarette sticks 25 and a double length filter plug 30 interposed axially between them, are  
20 released by the assembly roller 29 to a roller 32 forming part of a finishing unit 33, which also includes a unit 34 serving to cut and feed single tipping papers 35, and a rolling unit 36 by which the stick and filter plug assemblies 14 and the  
25 tipping papers 35 are received in succession and in such a way that each paper 35 can be rolled around a corresponding assembly to form a cigarette 2 of double length.

The double length cigarettes 2 are directed by way  
30 of an intermediate roller 37 toward a cutter device

38, and divided each in turn by a stroke made through the double length filter plug 11 in such a way as to generate two successions of single filter cigarettes 2 identical one to the other.

5       The two successions of filter cigarettes 2 are directed toward an outfeed unit 39 of the filter tip attachment machine 4, advancing first onto an overturning roller 40 by which the two successions are united to establish a single succession of  
10       cigarettes 2, then proceeding along a final train of rollers denoted 41 in its entirety, following a path along which the cigarettes 2 will undergo further processing steps of a familiar nature.

15       As illustrated for example in figure 1, the final train 41 of rollers, carried together with the aforementioned rollers 23, 26, 28, 29 and 32 by a vertical bulkhead A surmounting the frame B of the filter tip attachment machine 4, could include a roller 42 on which the cigarettes 2 are perforated  
20       by a laser device 43, and an inspection roller 44.

25       Still referring to figure 1, the monitoring and control system 5 comprises an auxiliary cigarette inspection unit 45 connected on an infeed side, by way of a cigarette sampling device represented as a block denoted 46, to a roller 47 operating at the  
outfeed 39 of the filter tip attachment machine 4.

30       The auxiliary inspection unit 45 is connected on the output side to a common interface network 48, both directly, by way of a link denoted 49, and indirectly by way of a respective signal processing

and routing unit represented as a block denoted 50.

The network 48 is connected in turn to each of the electrical systems typically controlling the single production devices and units making up the manufacturing line 1 as described above.

With reference also to figure 2, the auxiliary inspection unit 45 is connected to the line 1 by way of the sampling device 46, which comprises a diverter device 51 designed, when activated, to deliver a jet from a nozzle 52 connecting with a source 53 of compressed air, such as will eject a single cigarette 2 from a corresponding groove 54 of the outfeed roller 47. The sampling device 46 further comprises a conveyor device 55, pneumatic for instance, positioned to receive the ejected cigarette 2 and advance it along a direction D parallel with its own axis toward take-up means consisting in a first arm 56 equipped with suction means (not illustrated) and forming part of the auxiliary inspection unit 45.

Advantageously, the auxiliary inspection unit 45 in the example illustrated is designed to run a full check on certain key characteristics of the cigarette 2, and more exactly the quality of the outer cylindrical surface and the integrity of the filler at one or both ends of the cigarette 2.

The take-up arm 56 referred to above is aligned along the aforementioned conveying direction D and carried by a slide 58 mounted to a table 59 forming part of a frame 60 by which the unit 45 is housed.



The slide 58 is capable of movement thus along a relative direction D1 transverse to the conveying direction D, between a first position of alignment with the conveyor device 55, in which the single  
5 cigarettes 2 are received, and a second position shown by phantom lines in figure 2, in which the cigarette is released to a second arm 61 equipped with suction means (not indicated) and forming part of transfer means denoted 62 in their entirety.

10 The transfer means 62 comprise a rotary transfer mechanism denoted 63, carrying the second arm 61 and positioned so as to interact with a vertical channel 64 affording feed means down which the single cigarettes 2 are directed.

15 As discernible in figure 3, the rotary transfer mechanism 63 serves to flip the single cigarette 2, causing it to pivot about an axis 65 parallel to the transverse direction D1 mentioned above, and assume an upright position of alignment with the vertical  
20 channel 64.

When the suction means associated with the second arm 61 are deactivated, the cigarette 2 proceeds down the channel 64 toward a retaining and transfer unit 66 that combines with sensing and inspection  
25 means 67, illustrated in figures 2 and 4, to create a detection apparatus denoted 68 in its entirety.

As illustrated in figures 2 to 5, the retaining and transfer unit 66 comprises a support member 69 equipped with a frame 70 and, mounted to the frame,  
30 rolling means 71 comprising a pair of power driven

rollers 72 rotatable about parallel axes in the same direction and combining to create a seat 73 such as will accommodate a single cigarette 2.

5 The support member 69 is mounted so as to pivot on a horizontal axis O in such a way that the pair of rollers 72, and therefore the seat 73, can be moved from the position indicated in figure 3 in which a cigarette 2 is received, to the position indicated in figures 2 and 4, in which the seat 73 is inclined.

10 Accordingly, the cigarette 2 can be positioned appropriately in preparation for the action of the sensing and inspection means 67, in front of which it will be transferred by a movement of the support member 69 along a predetermined path P parallel to the horizontal axis O.

15 As illustrated in figures 4 and 5, the sensing and inspection means 67 comprise optical means 74 serving to inspect the entire surface of each cigarette 2, caused to rotate on its axis by the pair of rollers 72.

20 Also forming part of the sensing and inspection means 67 is at least one optical sensor 75 serving to verify that the end of the cigarette 2 is filled properly with tobacco.

25 The optical means 74 comprise a first television camera or lens 76 equipped with a relative optical assembly, capable of inspecting the entire outer surface of the cigarette 2, and a second television camera or lens 77 equipped with a relative optical

30

assembly, capable of stepping motion along the axis of the pair of rollers 72 and designed to inspect predetermined portions of the outer surface of each cigarette 2.

5 Referring to figure 5, the two cameras 76 and 77 are supported by a carriage 78 capable of movement, generated by an actuator not illustrated, along slide ways 79. A lamp 80 provides the illumination required to enable the optical inspection.

10 The cigarettes 2 are taken up at the outfeed 39 of the filter tip attachment machine 4 and directed into the auxiliary inspection unit 45 either in response to instructions entered in manual mode by the operator, or alternatively at predetermined  
15 intervals in automatic mode, in such a way as to implement a sample quality control.

It will be seen that the signals generated as a result of the quality testing steps performed by the auxiliary inspection unit 45 are relayed by the unit  
20 45 to processing and control units associated with each of the production devices and/or units installed along the manufacturing line 1.

Certain of these processing and control units are denoted 81 in figure 1.

25 Observing the example illustrated, in particular, the signals reflecting the characteristics of the outer surface or ends of the sampled cigarettes 2 will naturally be relayed to the processing and control units 81 associated with the devices or  
30 units on which the characteristics in question

depend, and thus able to bring about a correction of these same characteristics when necessary.

In the event, for example, that the inspection unit 45 should detect a malfunction of the printer device 16, or the unit 34 by which the tipping papers 35 are cut and fed, or the laser perforating device 43, the signals indicating the faults in question will be routed back to the processing and control units 81 associated with these same devices and units, in such a manner that the appropriate corrective action can be applied.

Accordingly, the auxiliary inspection unit 45 provides a feedback control for all the production devices or units operating on the manufacturing line 1, and the signals emitted by the unit 45 can be presented not only to the network 48, but also to the master control units governing each of the machines in the line 1.

Observing figure 1, it will be seen that the master control unit of the cigarette maker 3 is shown as a block denoted 82, and that of the filter tip attachment machine 4 as a block denoted 83.

Finally, the feedback signals can be presented, again via the network 48, to one or more visual display means 84 comprising video screens 85.

Referring to figures 6 and 7, which relate to a second embodiment of the sampling device 46, the device in question comprises a conveying take-up roller 86 rotating substantially tangential to the outfeed roller 47 of the filter tip attachment

machine 4 and furnished with aspirating grooves 87. The cigarettes 2 for inspection are taken up by the conveying roller 86 substantially in the manner disclosed in Italian patent IT 1,220,320, to which  
5 reference may be made for a full description. The cigarettes 2 are removed from the grooves 87 by extractor means 88 operating in conjunction with the roller 86, and directed to the entry point of shifter means 89 that can be made to assume two  
10 different positions, either automatically or when selected by an operator.

More precisely, in a first, or open position, shown by continuous lines in figure 6, the shifter means 89 establish a channel 90 created between two  
15 walls 90, denoted 90a on the left and 90b on the right as seen in the drawing, by which cigarettes 2 are fed to the pockets 91 of a pocket conveyor 92, typically intermittent in operation, extending between the outlet end of the channel 90 and the  
20 first arm 56 of the auxiliary inspection unit 45.

As illustrated in figure 6, the channel 90 can also occupy a second or closed position, shown by phantom lines, assumed when the top end of the one wall 90a is made by actuator means (not indicated)  
25 to enter into contact with the top end of the other wall 90b.

In this situation, a tray 93 serving to collect the cigarettes 2, supported by a shaft pivotable about a fulcrum denoted 94, is caused to rotate on  
30 this same fulcrum and to shift clockwise as viewed

in figure 6, thereby passing from a position of disengagement to a receiving position beneath the aforementioned extractor means 88, in which it can take up the cigarettes 2 coming off the roller 86.

5       The bottom end of the channel 90 will be seen to present a substantially "S" shaped profile, serving to attenuate the speed at which the cigarettes 2 drop into the pockets 91 and prevent the selfsame cigarettes 2 from becoming incorrectly positioned.

10       Referring to figure 7, the pocket conveyor 92 is looped around two pulleys of which a first is shown in figure 6 and denoted 95, whilst the second will be located above the first arm 56 of the auxiliary inspection unit 45.

15       The conveyor 92 extends along a predetermined path P1 of which at least one leg follows a line substantially transverse to the bulkhead A of the filter tip attachment machine 4.

20       More exactly, the conveyor 92 presents a first leg 97 extending horizontal and parallel to the vertical bulkhead A, followed by curved second and third legs 98 and 99 connected to a vertical fourth leg 100 of which the top end is connected in turn to a curved fifth leg 101, connecting with a final horizontal  
25       leg 102.

30       Passing along the final horizontal leg 102, the pockets 91 of the conveyor 90 are positioned with their axes parallel to the aforementioned arm 56, so that the cigarettes 2 can be transferred to the arm advancing in a direction substantially parallel to

the direction D1 along which the arm 56 itself is set in motion.

As discernible also in figure 7, the auxiliary inspection unit 45 is located outside the area occupied by the manufacturing line 1, and the cigarettes 2 are released to the receiving arm 56 without any mechanical or pneumatic stress being applied.

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